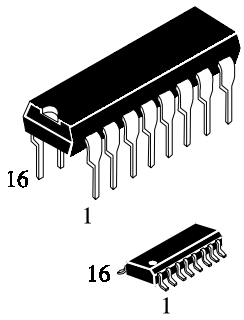
8-Bit Serial-Input/Serial or Parallel-Output Shift Register with Latched 3-State Outputs

High-Performance Silicon-Gate CMOS



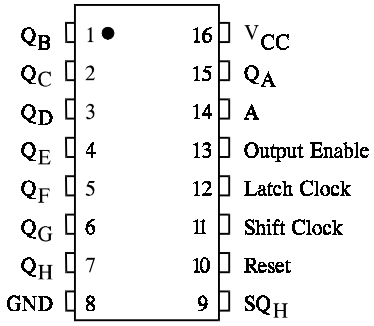
ORDERING INFORMATION
TC74HC595AN Plastic
TC74HC595AD SOIC
T_A = -55° to 125° C for all packages

The TC74HC595A is identical in pinout to the LS/ALS595. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LS/ALSTTL outputs.

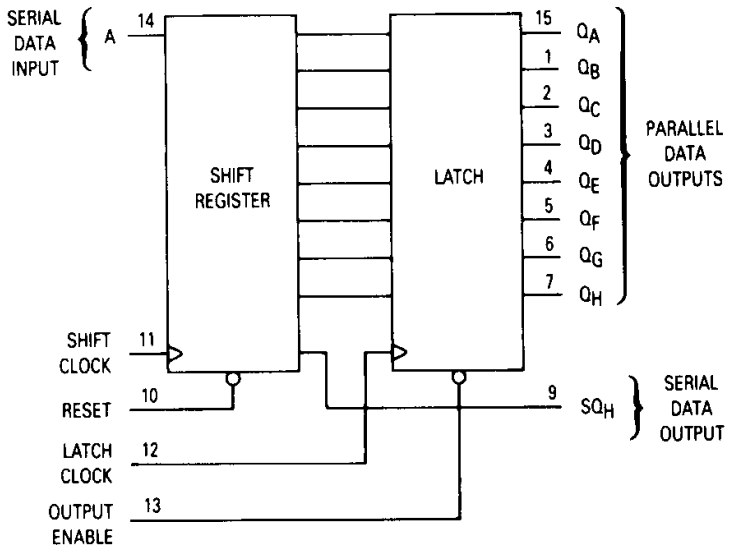
The TC74HC595A consists of an 8-bit shift register and an 8-bit D-type latch with three-state parallel outputs. The shift register accepts serial data and provides a serial output. The shift register also provides parallel data to the 8-bit latch. The shift register and latch have independent clock inputs. This device also has an asynchronous reset for the shift register.

- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V
- Low Input Current: 1.0 μA
- High Noise Immunity Characteristic of CMOS Devices

PIN ASSIGNMENT



LOGIC DIAGRAM



PIN 16 =V_{CC}
PIN 8 = GND

MAXIMUM RATINGS*

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
V_{IN}	DC Input Voltage (Referenced to GND)	-1.5 to V_{CC} +1.5	V
V_{OUT}	DC Output Voltage (Referenced to GND)	-0.5 to V_{CC} +0.5	V
I_{IN}	DC Input Current, per Pin	±20	mA
I_{OUT}	DC Output Current, per Pin	±35	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins	±75	mA
P_D	Power Dissipation in Still Air, Plastic DIP+ SOIC Package+	750 500	mW
Tstg	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature, 1 mm from Case for 10 Seconds (Plastic DIP or SOIC Package)	260	°C

*Maximum Ratings are those values beyond which damage to the device may occur.
Functional operation should be restricted to the Recommended Operating Conditions.
+Derating - Plastic DIP: - 10 mW/°C from 65° to 125°C
SOIC Package: : - 7 mW/°C from 65° to 125°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)		2.0	6.0	V
V_{IN}, V_{OUT}	DC Input Voltage, Output Voltage (Referenced to GND)		0	V_{CC}	V
T_A	Operating Temperature, All Package Types		-55	+125	°C
t_r, t_f	Input Rise and Fall Time (Figure 1)	V_{CC} =2.0 V V_{CC} =4.5 V V_{CC} =6.0 V	0 0 0	1000 500 400	ns

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{IN} and V_{OUT} should be constrained to the range GND≤(V_{IN} or V_{OUT})≤V_{CC}.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

DC ELECTRICAL CHARACTERISTICS(Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V_{CC} V	Guaranteed Limit			Unit
				25 °C to -55°C	≤85 °C	≤125 °C	
V_{IH}	Minimum High-Level Input Voltage	V_{OUT}=0.1 V or V_{CC}-0.1 V $\|I_{OUT}\| \le 20$ μA	2.0 4.5 6.0	1.5 3.15 4.2	1.5 3.15 4.2	1.5 3.15 4.2	V
V_{IL}	Maximum Low - Level Input Voltage	V_{OUT}=0.1 V or V_{CC}-0.1 V $\|I_{OUT}\| \le 20$ μA	2.0 4.5 6.0	0.5 1.35 1.8	0.5 1.35 1.8	0.5 1.35 1.8	V
V_{OH}	Minimum High-Level Output Voltage, Q_A-Q_H	V_{IN}=V_{IH} or V_{IL} $\|I_{OUT}\| \le 20$ μA	2.0 4.5 6.0	1.9 4.4 5.9	1.9 4.4 5.9	1.9 4.4 5.9	V
		V_{IN}=V_{IH} or V_{IL} $\|I_{OUT}\| \le 6.0$ mA $\|I_{OUT}\| \le 7.8$ mA	 4.5 6.0	 3.98 5.48	 3.84 5.34	 3.7 5.2	
V_{OL}	Maximum Low-Level Output Voltage, Q_A-Q_H	V_{IN}=V_{IH} or V_{IL} $\|I_{OUT}\| \le 20$ μA	2.0 4.5 6.0	0.1 0.1 0.1	0.1 0.1 0.1	0.1 0.1 0.1	V
		V_{IN}=V_{IH} or V_{IL} $\|I_{OUT}\| \le 6.0$ mA $\|I_{OUT}\| \le 7.8$ mA	 4.5 6.0	 0.26 0.26	 0.33 0.33	 0.4 0.4	
V_{OH}	Minimum High-Level Output Voltage, SQ_H	V_{IN}=V_{IH} or V_{IL} $\|I_{OUT}\| \le 20$ μA	2.0 4.5 6.0	1.9 4.4 5.9	1.9 4.4 5.9	1.9 4.4 5.9	V
		V_{IN}=V_{IH} or V_{IL} $\|I_{OUT}\| \le 4.0$ mA $\|I_{OUT}\| \le 5.2$ mA	 4.5 6.0	 3.98 5.48	 3.84 5.34	 3.7 5.2	
V_{OL}	Maximum Low-Level Output Voltage, SQ_H	V_{IN}=V_{IH} or V_{IL} $\|I_{OUT}\| \le 20$ μA	2.0 4.5 6.0	0.1 0.1 0.1	0.1 0.1 0.1	0.1 0.1 0.1	V
		V_{IN}=V_{IH} or V_{IL} $\|I_{OUT}\| \le 4.0$ mA $\|I_{OUT}\| \le 5.2$ mA	 4.5 6.0	 0.26 0.26	 0.33 0.33	 0.4 0.4	
I_{IN}	Maximum Input Leakage Current	V_{IN}=V_{CC} or GND	6.0	±0.1	±1.0	±1.0	μA
I_{OZ}	Maximum Three-State Leakage Current, Q_A-Q_H	Output in High-Impedance State V_{IN}= V_{IL} or V_{IH} V_{IN}=V_{CC} or GND	6.0	±0.5	±5.0	±10	μA
I_{CC}	Maximum Quiescent Supply Current (per Package)	V_{IN}=V_{CC} or GND I_{OUT}=0μA	6.0	4.0	40	160	μA

AC ELECTRICAL CHARACTERISTICS(C_L=50pF,Input t_r=t_f=6.0 ns)

Symbol	Parameter	V_{CC} V	Guaranteed Limit			Unit
			25 °C to -55°C	≤85 °C	≤125 °C	
f_{max}	Minimum Clock Frequency (50% Duty Cycle) (Figures 1and 7)	2.0 4.5 6.0	6.0 30 35	4.8 24 28	4.0 20 24	MHz
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Shift Clock to SQ_H (Figures 1and 7)	2.0 4.5 6.0	140 28 24	175 35 30	210 42 36	ns
t_{PHL}	Maximum Propagation Delay , Reset to SQ_H (Figures 2 and 7)	2.0 4.5 6.0	145 29 25	180 36 31	220 44 38	ns
t_{PLH}, t_{PHL}	Maximum Propagation Delay , Latch Clock to Q_A-Q_H (Figures 3 and 7)	2.0 4.5 6.0	140 28 24	175 35 30	210 42 36	ns
t_{PLZ}, t_{PHZ}	Maximum Propagation Delay , Output Enable to Q_A-Q_H (Figures 4 and 8)	2.0 4.5 6.0	150 30 26	190 38 33	225 45 38	ns
t_{PZL}, t_{PZH}	Maximum Propagation Delay , Output Enable to Q_A-Q_H (Figures 4 and 8)	2.0 4.5 6.0	135 27 23	170 34 29	205 41 35	ns
t_{TLH}, t_{THL}	Maximum Output Transition Time, Q_A-Q_H (Figures 3 and 7)	2.0 4.5 6.0	60 12 10	75 15 13	90 18 15	ns
t_{TLH}, t_{THL}	Maximum Output Transition Time, SQ_H (Figures 1 and 7)	2.0 4.5 6.0	75 15 13	95 19 16	110 22 19	ns
C_{IN}	Maximum Input Capacitance	-	10	10	10	pF
C_{OUT}	Maximum Three-State Output Capacitance (Output in High-Impedance State), Q_A-Q_H	-	15	15	15	pF

C_{PD}	Power Dissipation Capacitance (Per Package) Used to determine the no-load dynamic power consumption: $P_D=C_{PD}V_{CC}^2f+I_{CC}V_{CC}$	Typical @25°C,V_{CC}=5.0 V 300	pF

TIMING REQUIREMENTS(C_L=50pF,Input t_r=t_f=6.0 ns)

Symbol	Parameter	V_{CC} V	Guaranteed Limit			Unit
			25 °C to -55°C	≤85°C	≤125°C	
t_{su}	Minimum Setup Time,Serial Data Input A to Shift Clock (Figure 5)	2.0 4.5 6.0	50 10 9	65 13 11	75 15 13	ns
t_{su}	Minimum Setup Time, Shift Clock to Latch Clock (Figure 6)	2.0 4.5 6.0	75 15 13	95 19 16	110 22 19	ns
t_h	Minimum Hold Time, Shift Clock to Serial Data Input A (Figure 5)	2.0 4.5 6.0	5 5 5	5 5 5	5 5 5	ns
t_{rec}	Minimum Recovery Time, Reset Inactive to Shift Clock (Figure 2)	2.0 4.5 6.0	50 10 9	65 13 11	75 15 13	ns
t_w	Minimum Pulse Width, Reset (Figure 2)	2.0 4.5 6.0	60 12 10	75 15 13	90 18 15	ns
t_w	Minimum Pulse Width, Shift Clock (Figure 1)	2.0 4.5 6.0	50 10 9	65 13 11	75 15 13	ns
t_w	Minimum Pulse Width, Latch Clock (Figure 6)	2.0 4.5 6.0	50 10 9	65 13 11	75 15 13	ns
t_r, t_f	Maximum Input Rise and Fall Times (Figure 1)	2.0 4.5 6.0	1000 500 400	1000 500 400	1000 500 400	ns

FUNCTION TABLE

Operation	Inputs					Resulting Function			
	Reset	Serial Input A	Shift Clock	Latch Clock	Output Enable	Shift Register Contents	Latch Register Contents	Serial Output SQ_H	Parallel Outputs Q_A-Q_H
Reset shift register	L	X	X	L,H,	L	L	U	L	U
Shift data into shift register	H	D	↑	L,H,	L	D → SR_A SR_N → SR_{N+1}	U	SR_G - SR_H	U
Shift register remains unchanged	H	X	L,H,	L,H,	L	U	U	U	U
Transfer shift register contents to latch register	H	X	L,H,	↑	L	U	SR_N → LR_N	U	SR_N
Latch register remains unchanged	X	X	X	L,H,	L	*	U	*	U
Enable parallel outputs	X	X	X	X	L	*	**	*	Enabled
Force outputs into high-impedance state	X	X	X	X	H	*	**	*	Z

SR = shift register contents

LR = latch register contents

D = data (L,H) logic level

U = remains unchanged

X = don't care

Z = high impedance

* = depends on Reset and Shift Clock inputs

** = depends on Latch Clock input

PIN DESCRIPTIONS

INPUTS:

A - Serial Data Input. The data on this pin is shifted into the 8-bit serial shift register.

CONTROL INPUTS:

Shift Clock - Shift Register Clock Input. A low-to-high transition on this input causes the data at the Serial Input pin to be shifted into the 8-bit shift register.

Reset - Active-low, Asynchronous, Shift Register Reset Input. A low on this pin resets the shift register portion of this device only. The 8-bit latch is not affected.

Latch Clock - Storage Latch Clock Input. A low-to-high transition on this input latches the shift register data.

Output Enable - Active-Low Output Enable. A low on this input allows the data from the latches to bepresented at the outputs. A high on this input forces the outputs (Q_A-Q_H) into the high-impedance state. The serial output is not affected by this control unit.

OUTPUTS:

Q_A-Q_H - Noninverted, 3-state, latch outputs.

SQ_H - Voninverted, Serial Data Output. This is the output of the eighth stage of the 8-bit shift register. This output does not have three-state capability.

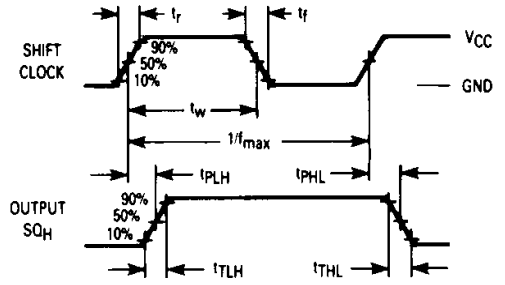


Figure 1. Switching Waveforms

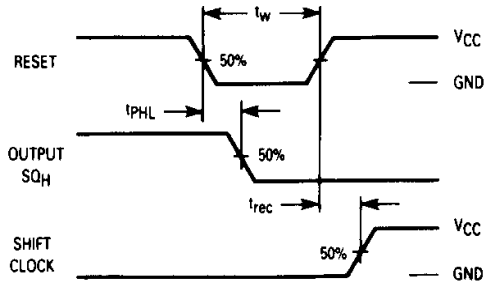


Figure 2. Switching Waveforms

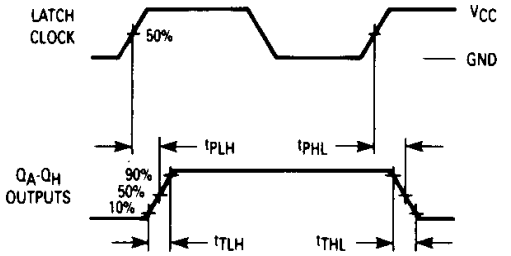


Figure 3. Switching Waveforms

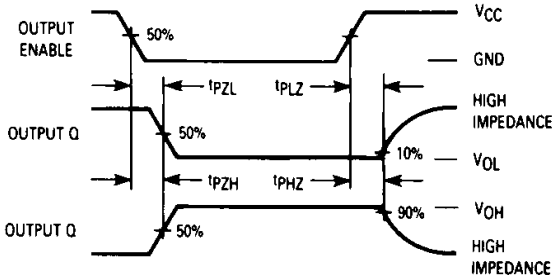


Figure 4. Switching Waveforms

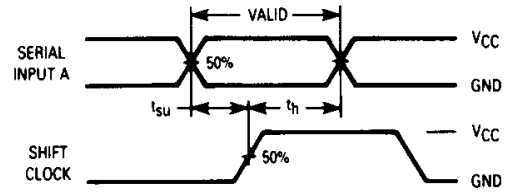


Figure 5. Switching Waveforms

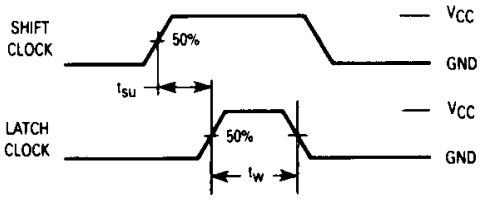


Figure 6. Switching Waveforms

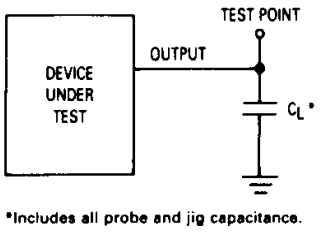


Figure 7. Test Circuit

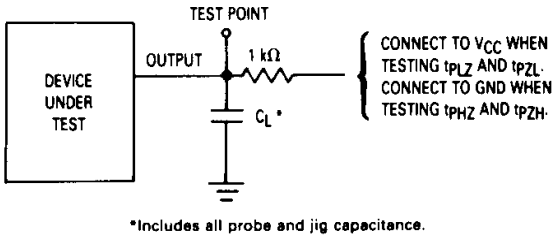
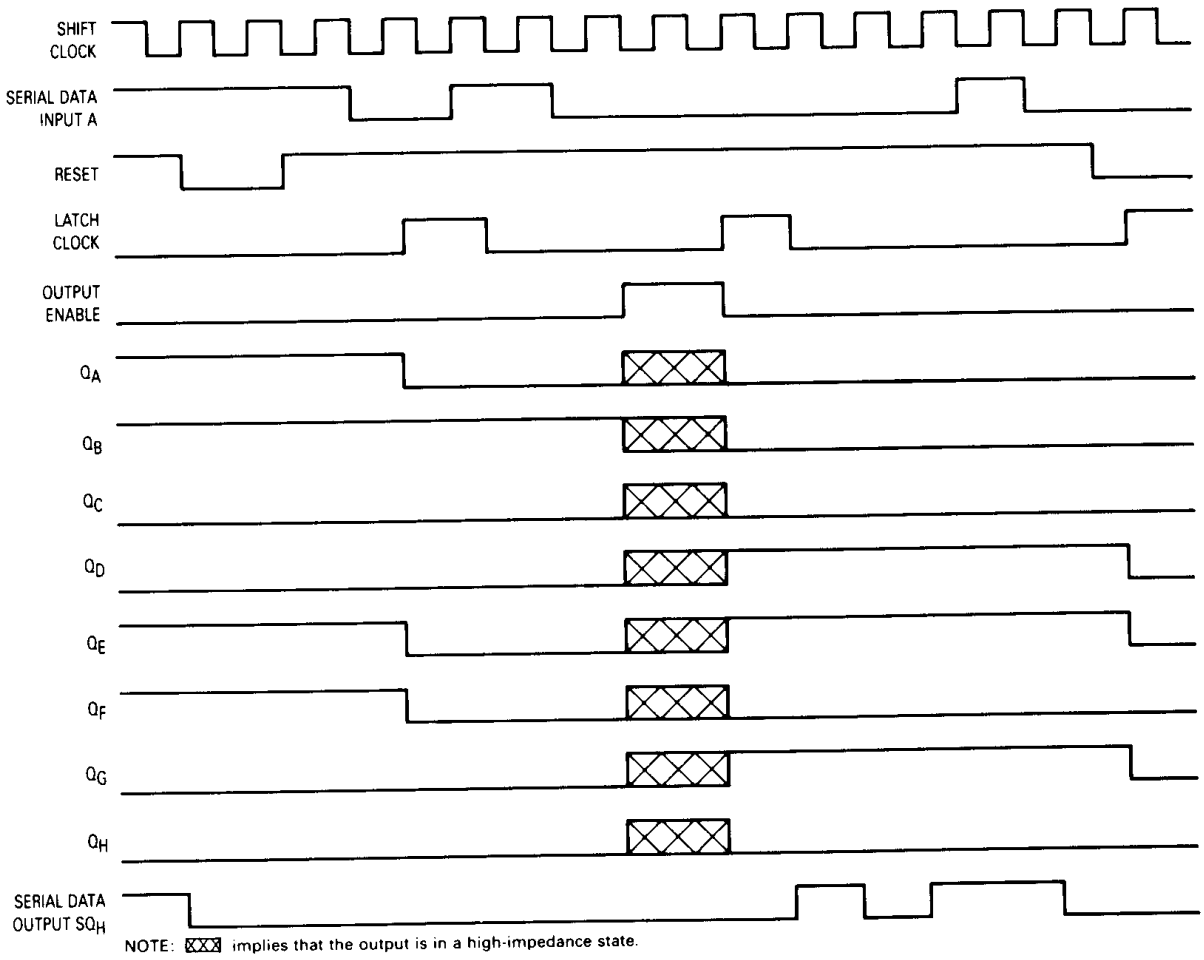


Figure 8. Test Circuit

TIMING DIAGRAM



NOTE: XXX implies that the output is in a high-impedance state.

EXPANDED LOGIC DIAGRAM